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*THE STATE UNIVERSITY AND RESEARCH.**

IT is the privilege of the private school, the denominational institution and the independent university to select the phases of education to which they shall devote themselves; but the appropriate sphere of a state system of education is predetermined by the inherent relations which the state sustains. The function of all state institutions is the welfare of the commonwealth. By first intention, the state is not concerned with the individual, but with the aggregate body of its citizens. The state must necessarily deal with individuals, but rather as integers of the aggregate body than *as* individuals. State education, therefore, in the strictest construction, and in the highest ideal, is the education of the aggregate body that forms the commonwealth. Education from the view-point of other institutions may deal primarily with the individual, and only secondarily with the aggregate. State education deals primarily with the aggregate, and only incidentally with the individual as a constituent of the aggregate. Obviously I am defining the ideal rather than the actual fact of practice; rather of the goal to be at length attained than any present achievement.

In its earliest stages, formal education seems to have been altogether individual. Gradually it grew to be the privilege of select classes, and at length, but only at a late day and among the foremost peoples, it has come to be a possibility for all.

* One of the two convocation addresses given on the occasion of the semicentennial jubilee of the University of Wisconsin.

Parallel with this extension of personal privilege, there has been a growth in the breadth of the educational conception. The elevation of the aggregate intellectuality of the people has begun to succeed the narrower idea of the education of the individual simply. To paraphrase the immortal apothegm of Lincoln, primitive education was of the individual, by the individual, and for the individual. The state's ideal effort is the education of the commonwealth, by the commonwealth and for the commonwealth.

Lest this shall seem mere borrowed rhetoric, let us examine the fundamental source of education in the ulterior sense, as distinguished from the technical and narrow sense. It need not be affirmed that education is broader than 'schooling.' The development of mind and character begins before the school is entered, and continues long after the halls of learning are abandoned. Education is begun when thought, feeling and activity begin, and ceases only when thought, feeling and activity cease to be susceptible of modification. At all times, a large part of the educational influences lie outside the schools. Education is derived from every mental contact; it is absorbed from the whole intellectual environment; it is inspired by infinite sources of stimulus. The course in the schools are merely a limited selection from possible means, chosen for supposed effectiveness during the receptive and formative stages.

The *fundamental* and *ulterior* sources of education do not lie in the conventional schools, but back of them. These sources can not here be defined at length, but in a simple phrase, they may be said to lie in *the great stock of ideas possessed by mankind.* This phrase inadequately embraces the whole, but let us agree that it may stand for the whole. In so far as the stock of ideas of a people is narrow, defective and erroneous, on the one hand, or broad, demonstrative and exact, on the other, in so far the fundamental subject-material of education partakes of these qualities. In so far as the sentiments, beliefs, attitudes and activities of a people are narrow, loose and perverted, on the one hand, or free, generous and ethical, on the other, in so far education inevitably shares in these qualities. *For these are the fundamental sources of education.* The basal problem of education is, therefore, concerned with the entire compass of the intellectual possessions of a people, and, in a measure, of all mankind. The special selections propagated in the schools are but a miniature reflection of the total possession, and this selection is usually noble or mean, as the whole is noble or mean.

If these considerations are true, the *fundamental* promotion of education lies in an increase of the intellectual possessions of a people, and in the mental activities and attitudes that grow out of the getting, the testing and the using of these possessions.

In the education of the individual, the personality of the instructor counts for much. In the education of a people, the personality of a teacher is fused with the multitude of other, and often conflicting, personal influences, and, unless it be phenomenal, it is submerged. But determinate truths work together for permanent results. These results often lie athwart the trend of personal inculcations. True ideas work incessantly and unswervingly toward a destined end, while the thousand little waves of merely personal influence cross one another's paths and work one another's destruction. Determinate truth is radioactive, and sends forth a constant stream of penetrating, illuminating emanations, to which only the most leaden intellect is opaque. The discoverers of great truths and the authors of great ideas are the great educators.

The education of the individual does not necessarily lift the education of the aggregate, for if we convey to the rising generation only such ideas as we have inherited, the summit-level of education is not raised. There may be diffusion—there may be an evening up—but no lifting of the upper levels. If the intellectuality of the new generation does not rise above that of the old, there is only a Chinese dead-level of ancestral propagation.

If we are agreed upon this, let us turn to the question, *How is real educational advancement to be secured?*

Some progress may be made in a live people by voluntary research and by the incidental accretions of common experience, but if our intellectual estate be left to such sporadic and unsystematic agencies, growth is a creature of uncertainty. If perchance there be laudable growth, it is scant credit to the state. If the enrichment of our intellectual world be left to spontaneous individual action, it can not be hoped that it will be continuous or systematically directed. It will follow the diverse lines that chance to be inviting to individuals. Inquiries will be taken up and dropped at pleasure, and will be limited by scant resources. There is as good chance of finding a rich man in heaven as in a laboratory.

To secure laudable progress in the fundamental conditions of education, systematic provision for scientific research is requisite. By scientific research I do not, of course, mean physical research alone, but rigorous investigation in any field. To give this research its best adaptations to the needs of a people, it should be systematically controlled in the lines most tributary to these needs. To make the results available to all who will use them, suitable means for dissemination are requisite. Inevitably the highest intellectual training will grow out of this, for such training is both the prerequisite and the outcome of the struggle to find truth and to test it. Out of this training will come the best possible development of intellectual capacity, of right attitude toward truth, and of considerate action controlled by the scientific spirit.

With the majority of Wisconsin people I hold that it is a legitimate function of the state to train boys to be farmers, but I believe it to be a much higher and truer function to develop the science of agriculture, to increase the intellectual activity of every farmer, to improve the agricultural art on every farm, and by such improved art, to furnish better and safer food to every citizen. That such a result is not an idle dream need not be affirmed in Wisconsin. Gigantic steps towards its realization have already been taken. The material results you know, for they are tangible. The intellectual and moral results more easily elude recognition. I venture to cite a personal observation. It was my privilege to compare the agricultural conventions of this state at two periods separated by a decade, within which the experiment station became a potent influence. The dominant intellectual and moral attitude of the earlier period was distinctly disputatious and dogmatic. Opinions and floating notions played the part that should have been reserved for demonstrations. Interpretations were loose, and close analyses rare. In the second period, the dominant attitude was that of a scientific conference. Opinions were replaced by demonstrations, or by tentative hypotheses. Conviction was sought by the presentation of determinate facts, gathered by experiment and laborious observation, carefully analyzed and cautiously interpreted. The whole was characterized by a notable approach to the methods of approved scientific procedure. The intellectual and moral contrast of the two periods was one of the most pronounced expressions of advance in the higher education in a great mass of

people in the midst of practical life which it has ever been my privilege to witness.

If the state educates an engineer, it promotes the common safety, which is threatened by an ever-increasing multitude of new contingencies springing from new devices in construction, transportation, sanitation, electric lighting, *et cetera*. But if the state creates and spreads broadcast engineering science, it makes protective intelligence more nearly a common possession, and lays the groundwork for universal caution and for intelligent watch over every one who holds the power of life and death in his hands. The supreme function of the state's college of engineering is rather the creation and dissemination of engineering science than the personal training of a technologist.

If the state educates a physician, it confers a benefit on the commonwealth by so much as he contributes locally to the public health. But if the state investigates the cause of disease and the mode of prevention and cure, and propagates the results, every citizen, directly or indirectly, becomes a beneficiary, and the interests of the whole people are conserved.

Doubtless it is a proper function of the state university to train lawyers, for their public service is indispensable, but it is a higher function to develop the science of law-making. The subject matter now taught relates chiefly to the application and consequences of laws already enacted, and especially to the litigation that springs from their obscurities or defects. Should not the chief effort lie back of this in investigation precedent to law-making? With suitable provisions, the history of every law passed by the legislature may be traced by the methods of historical science, its workings measured with approximate accuracy, and its adaptation to its purpose scientifically determined. Similar determinations in other commonwealths are equally possible. Comparison between these, when sufficiently multiplied and critically discussed, should give a basis for determining the best mode of legislative treatment with something of the confidence that clinical records give to surgical or pathological treatment. The important function of law-making may be subjected to the same antecedent processes of scientific inquiry, of judicial induction, and of intellectual caution and equipoise that obtain in medicine, mechanics or agriculture. This may at present seem Utopian because of regnant practise and prepossession to the contrary, but, given the same patience and ingenuity, why may we not treat the history of laws in the same critical, deliberate way that the scientific pathologist treats the history of disease, or the scientific surgeon the history of an operation? It will not be denied that if the modes of scientific research controlled this field, so especially the function of the state, it would be as beneficent in its sphere as scientific pathology is in its realm, or the high art of surgery in its field. Beyond this historical treatment, there is the great untouched field of *systematic experimentation in legislation under scientific control*—but the next speakers would have good cause for action at court if I entered on this untrodden field.

These citations are merely illustrative selections. Research in every realm of a people's legitimate interests is an appropriate function of the people's *organized self*, the state, and of the people's *organized instrument of research*, the state university.

The people of Wisconsin are to be congratulated on the important initial steps already taken by their university towards the fulfillment of its higher sphere. They are to be warmly felicitated on the larger effort upon which the new administration of the university has already entered with so much of vigor and enthusiasm. They are to be congratulated on the acknowl-

edged ability of their new leader to direct the development of investigation in fruitful lines, an ability already eminently demonstrated by personal researches. It is a further ground of high hope that he adds to commanding ability and fruitful experience, so large and so true appreciation of the higher function of a state university.

Conscious of my personal partiality, I yet believe that in truth the University of Wisconsin is a leader among its class in this higher field of research. But no university has yet fully entered upon it. Which shall be the first to become predominantly an institution of research? Which shall be the first to fulfill the high destiny of an ideal state university? Citizens of Wisconsin, given the means and the moral support, your new educational chief will lead forward with gigantic strides your beloved institution into this upper and broader field of usefulness. Will the means and the moral support be forthcoming? T. C. CHAMBERLIN.

UNIVERSITY OF CHICAGO.

THE MOSELY EDUCATIONAL COMMISSION. II.

IN most American colleges the arts course occupies four years; in a few only is it possible to graduate in three years. At Harvard College, where the subject of the length of the course has long been under discussion, it has recently been determined to allow students to attain the bachelor of arts degree in three or three and a half years, instead of four years; but owing to the improvement in the courses of instruction it will be possible to require from candidates who obtain the degree in the shorter period evidence of higher scholarship than has been expected of their predecessors at the end of four years. The arts course at the Johns Hopkins University extends over three years; but the standard of matriculation is said to be considerably higher than that maintained by institutions which require a residence of four years. The question whether the professional schools of the universities shall require a degree in arts or science from all candidates for admission is now being much debated. There is clearly a strong desire to raise the standard. This is well expressed in the following passage from the report made by President Eliot, of Harvard, at the close of 1902:

> Since the wise and efficient conduct of American affairs, commercial, industrial and public, depends more and more upon the learned and scientific professions, the universities owe it to the country to provide the best possible preparation for all the professions. This best possible preparation can only be given to young men who up to their twenty-first year have had the advantages of continuous and progressive school and college training.

President Eliot gives the following table showing the proportion in nine universities in which law and medical students holding a preliminary degree stand to all students:

Universities.	Holders of a Preliminary Degree.	Whole Number of Law and Medical Students.	Per Cent. of Holders of a Preliminary Degree.
Harvard	886	1,134	78.1
Columbia	562	1,260	44.6
Pennsylvania	331	928	35.6
Northwestern	220	691	31.8
Michigan	216	1,367	15.8
Yale	119	398	29.9
California	118	269	44.0
Chicago (Med.) ...	100	325	30.7
Cornell	75	607	12.3

Harvard University "has definitely determined to pursue the policy of requiring for admission to its professional schools a preliminary degree and has already applied this policy in all its professional schools except the dental school. The result has been an improvement in its professional schools striking in proportion to the strength of the contrast between the former students and the present in regard to their previous training."

At the Johns Hopkins University, candidates for the degree of doctor of medicine must be college graduates or must give evidence by examination that they possess attainments indicated by a baccalaureate degree in arts or science. Entering college at eighteen, the student is twenty-one or twenty-two years old on commencing this course of professional study; he is, therefore, at least twenty-five or twenty-six at the conclusion of the medical course. A period of post-graduate instruction at home or abroad is then often entered upon. It is not unlikely that the example set by law and medicine will erelong extend to other professions. The undue length of the course of study thus arranged has naturally attracted attention. Recently President Murray Butler, in particular, has commented on it and has proposed a further curtailment of the course. There are instances of such curtailment already. Thus at Cleveland, Ohio, where the Adelbert College and the Case School of Applied Science exist side by side, each having a complete four years' course, it has been arranged to give a double degree at the end of five years to those who have spent three years in the college and then two years in the school of applied science. President Butler proposes that the B.A. degree given at the end of a two years' prescribed college course shall be made the condition of entry to a professional course. He would give the M.A. degree to those who have followed an arts course during four years.

It is remarkable that a people supposed to be practical, like the Americans, should be prepared to devote so long a period to study. I had many conversations on the subject, in which I expressed my surprise; but I must confess that, as a rule, my friends seemed surprised that I should take up such an attitude. I am almost led to doubt whether, in matters of education, our American cousins may justly be regarded as a practical people. A course of study prolonged to an age bordering on thirty rather than twenty implies a most serious limitation on the period during which the individual exercises independence; it casts an improper burden on parents; and it postpones the age of marriage unduly. This last point especially deserves some consideration. The following table, given by President Eliot in his report, records the number of surviving children of members of six classes graduated from Harvard, from twenty-five to thirty years after graduation:

Class of	Number of A. B.'s.	Number Married.	Number of Children Surviving, 1902
1872.....	114	82	165
1873.....	131	96	181
1874.....	165	124	247
1875.....	141	90	171
1876.....	142	106	212
1877.....	188	136	286
	881	634	1,262

He points out that:

> If it be assumed that the surviving children are about one half males, it follows that the six classes have by no means reproduced themselves; that they have, indeed, fallen 28 per cent. short of it. Twenty-eight per cent. of the members of these classes are unmarried; and those who are married have, on the average, only two surviving children; so that the married pairs just reproduce themselves on the average.

It is impossible to overlook the significance of such facts. Again, to quote President Eliot:

> The table suggests that the highly-educated part of the American people does not increase the population at all, but, on the contrary, fails to reproduce itself. If many other colleges and universities publish class reports analogous to the Harvard reports a competent statistician might establish from the assembled reports some interesting and important conclusions. It is probable that the regrettable result indicated in the table is due in part to the late postponement of marriage on the part of educated young men, a postponement which the protracted education now prescribed for

men who enter the learned and scientific professions makes almost unavoidable. The young physician, lawyer, engineer or architect is now fortunate if he marries at twenty-eight or twenty-nine; whereas he should have married at twenty-five or twenty-six. To make earlier marriage possible is one of the strong inducements for bringing to an end the school course at seventeen or eighteen, the college course at twenty or twenty-one, and the professional training at twenty-four or twenty-five.

Our blind belief in academic methods of training has, perhaps, led us to overlook yet other all-important reasons for shortening the courses. While at college or technical school the student is not only withdrawn from the world of experience—and that, too, during the most susceptible period of youthful freshness—but is always dominated by teachers; the time is so entirely spent in learning from others that there is no possibility of properly developing either imaginative power or individuality. Therefore, not only is physical power sacrificed, but mental procreative power also—this latter surviving only in the genius; whereas, in reality, if education were of true avail, its one great and chief office should be to call forth and develop whatever spirit of originality, whatever element of genius, may lurk in the mind.

Over-teaching seems to me to be the bane of American schools of every grade, even more than of ours. And there is grave danger, especially in America, that the work of education may be over-organized. Classes are being formed to give special instruction in every section of every subject; in consequence, much time is wasted in doing formally what might be done far more rapidly and effectively informally when occasion requires, under intelligent direction or with the aid of properly written instructions.

It would almost seem that higher education is being given mainly in the interests of those who are to occupy secondary positions. The industrial leaders in America, it is said, are mostly men who have not enjoyed the so-called advantages of a liberal education. They are men with minds unfettered by the traditions which education, as now given, is only too likely to impart, yet trained in the world of experience, possessed of common sense. But there are exceptions which show that training in scientific method may be of advantage: a number of the men now at the head of the metallurgical industries commenced their careers as chemists—not as engineers, be it noted.

The entire system of education, both here and in America, seems to require reconstruction from bottom to top; it would be well, if I may say so, if we could scrap the whole wretched academic show and start afresh, in order that it may be greatly improved in quality and shortened in duration. Two ideals should be kept in view—we should aim at the development of individuality and encourage productivity. If a proper foundation were laid during early years a vast amount of time would be saved later on; if children were taught really to read, if they were thoroughly practised in the rudiments of scientific method, if they were even allowed to remain

> Perplext in faith, but pure in deeds,

there would be little that they could not afterwards accomplish within a reasonable time, because honesty of purpose would prevail among them and they would work with understanding and resist all but necessary guidance. The greater part of the work which is now done—far too late—at college might then be done at school; or, still better, college might be entered with advantage at sixteen. We need to remember that, as Buckle tells us, the acquisition of fresh knowledge is the necessary precursor of every step in social progress, and must itself be preceded by a love of inquiry

and, therefore, by a spirit of doubt. One great reason of failure is that nearly all our teaching is dogmatic. To use Tennyson's words:—

> There lives more faith in honest doubt,
> Believe me, than in half the creeds.

We need to introduce broader and more philosophical conceptions into our educational practise; it is almost impossible to keep pace with the growth of knowledge and absurd to add perpetually to the burden imposed upon the student. Moreover, it is unnecessary. If more attention were paid to teaching principles and their application, less to mere facts, many of the difficulties with which the student's path is now strewn would disappear and he would do effective work; our higher education is unfortunately afflicted with the disease of fact-megalomania; if the meaning of one tenth of the facts we now lay before the student were properly taught, the remaining nine tenths might safely be jettisoned.

As a very large number of American teachers have studied in Germany and the teaching is often based on German models, it is remarkable that the university system should bear so little resemblance to that of Germany. As a rule, far more routine work is done and far less attention is paid to research work than in Germany. At Cornell University, for example, although the course laid down for students of chemistry covers four years, no thesis work is demanded. At the Johns Hopkins University, on the other hand, the graduate student who desires to take the Ph.D. degree follows a course almost precisely similar to the German course; but this comes after a two years' graduate course, which has no equivalent in the German system. Of late years, however, much attention has been given to research work in America; still, it is not yet rated at its proper value and those who are engaged in the work by no means enjoy the esteem they deserve on that account. Professor Richards, of Harvard, for example, a chemist of brilliant originality as well as an extraordinarily exact worker, was not appreciated by his university until after he had been 'called' to Göttingen. Work which has no commercial aim or value is not easily recognized as important. As the spirit of inquiry is the mainspring of progress, its cultivation should be a first charge on the bank of education. Germany has long recognized this to be the case, but neither in the United States nor here does such a conclusion yet meet with acceptance. As the prizes offered by industrial enterprise are most alluring, it is essential that more active measures should be taken to develop the capacity for research, so that a larger supply of competent investigators should be forthcoming. And such men are sorely needed to act as leaders in every grade of education.

Science in the Service of the State.—The most striking illustrations of American organizing ability are to be met with at Washington. So far as I am aware, there is nothing anywhere to compare with the way in which science is being utilized in the service of the state by the U. S. Department of Agriculture, which is located in the capital. The origin and development of this department are sketched in a separate bulletin published in 1898. It was established by an act of congress approved by President Lincoln, May 15, 1862. Up to July 1, 1897, it cost, all told, $26,915,988, or less than $500,000 a year.

The department now comprises the following branches: Office of the secretary, the weather bureau, bureau of animal industry, bureau of plant industry, bureau of forestry, bureau of chemistry, bureau of soils, bureau of statistics, division of entomology, division of biological survey, division of accounts and disbursements, division of publications, office of experimental

stations, office of public road inquiries, library.

Agricultural experiment stations have been established in each state of the union under the Hatch Act of March 2, 1887. Agriculture is also supported by the endowment of agricultural colleges under the Morrill Law of August 30, 1890, out of funds arising from the sale of public lands. A list of the agricultural colleges and experiment stations, together with particulars as to courses of study, etc., is given in a separate bulletin (No. 122) published by the department. The organization of the department in 1903–4, together with a brief statement of the work of each division, is to be found in a special circular (Division of Publications Circular No. 1). Full particulars as to the appropriations for the current year are contained in the act (Public No. 158). A year after its organization its entire force consisted of 29 members, mostly clerks. On July 1, 1902, the staff numbered 3,789, of whom 1,209 were executive officers, clerks and messengers, 2,081 scientific investigators and 499 laborers.*

The Agricultural Department in Washington is not merely an office—it is also a busy hive of research. A large number of laboratories are attached to it, in which investigations are being carried on, bearing, in one way or another, on problems in agriculture. Much research work is also done in the state experiment stations; in the main, however, these serve to bring under the notice of farmers the importance of science to agriculture by demonstrating the value of methods of cultivation, manures, etc. There is no question that the research work done under the auspices of the agricultural department and in the experiment stations is of the very greatest value, and is contributing most materially to the development of agricultural industry. To take only one illustration, whereas, in 1884, the amount of sugar made from sugar beet was only about 300 tons, the beet crop of the past year is estimated to yield 400,000 tons; the amount of sugar made in the United States from the sugar cane being only about 300,000 tons. This extraordinary increase, I believe, is due practically entirely to the influence exercised from Washington. A map showing the regions in which the temperature conditions were favorable to the growth of the sugar beet was first prepared by Dr. Wiley, the head of the bureau of chemistry. Seed was then issued to farmers in various districts, together with directions how it was to be dealt with, and the produce was subsequently examined for sugar; in this way it was determined where the beet could be grown successfully. The advantages to be derived from the cultivation of the crop were also made clear to the farmers. An industry of great importance has in this way been gradually brought into existence; at the same time, farming practise has been vastly improved and land has increased considerably in value owing to its having received proper treatment.

The department is undoubtedly exercising an extraordinary influence on the education of farmers by distributing literature among them and by encouraging and helping them in every possible way; indeed, it is certain that, by one means or another, the American farmer is gradually being led to see that science is indispensable to agriculture.

The work that is being carried on in New York state under the direction of Professor Bailey, the director of the College of Agriculture at Cornell University, Ithaca, may be referred to in further illustration, as

* Since this report was in type I have received summary reports of work done in various bureaus of the department: I owe them to the kindness of their several chiefs. It is impossible now to notice them in this report, but I trust to be able to deal with them specifically elsewhere.

this is now a head center of the nature-study movement. The character of one branch of the work may be best made clear by the reproduction of the following circular letter relating to a reading course for farmers:

To the Editor,

Will you not help us to reach the farming community by inserting the following note? The reading course described below is provided for the farmer by state appropriation. We want him to receive the fullest possible benefit. Kindly send us a marked copy of the issues containing this notice.—Very truly yours,

S. W. Fletcher,
Supervisor of Farmers' Reading Course.

WINTER EVENINGS ON THE FARM.

The wide-awake farmer is now wondering what he can do in the long winter evenings to aid him in the work of next season. He would like to know more about the things with which he has to do; how he can feed his crops better; how he can make a piece of 'worn out' land fertile once more; how he can get the greatest feeding value from the stock of hay and grain in his barn. Many of these practical questions are in his mind at this time.

We would suggest that one of the best ways of answering them is through the 'Farmers' Reading Course,' conducted by the College of Agriculture of Cornell University. Once each month, from November to March, a short lesson on some practical farm topic is sent to each member. These lessons are written in a plain way, so that any farmer can readily understand. The only expense to the reader is an occasional stamp in reply. Many thousand New York farmers are now enrolled in this reading course. All that is necessary to become a member is to send your name on a postal card to Farmers' Reading Course, Ithaca, N. Y. The state pays for this work, and every one in the state interested in farming has a right to its benefits.

For many years Professor Bailey has been studying the improvement of the grounds of rural schools. Recognizing that the school playgrounds are, as a rule, 'bare, harsh, cheerless, immodest!' he has sought to interest those connected with the schools in making them attractive and has put forward hints for the proper laying out of the grounds. The literature on this subject issued from Cornell is of a most valuable character.

But perhaps the most interesting of the movements going on under Professor Bailey's influence is the formal organization of junior naturalist clubs in schools all over the state. This is under the direction of Mr. John W. Spencer, known as Uncle John, whom I had the privilege and pleasure of meeting. The object of such clubs "is the study of nature to the end that every member thereof shall love the country better and be content to live therein. Each member is expected to tell Uncle John at least once a month by letter or by drawings what he or she has seen or thought on some topic in nature-study suggested by the teacher or by the bureau of nature study." These letters are duly registered and read. On the receipt of the fourth, a badge-pin is sent to be worn as a testimony that the owner is entitled to all the honors due to a young naturalist. At intervals, Uncle John writes a letter to his young friends. These letters are full of charm.

Teachers' leaflets and a 'nature-study monthly' are issued in connection with the enterprise. The number of children enrolled is over 35,000. There can be no doubt that a pioneer work of great importance is being done, on which it will be possible to build in the future. It is not possible now to discuss in any proper way the method of teaching adopted. I desire to say everything in its favor, feeling as I do that the object in view is all important; but I am satisfied that the work lacks depth and that those engaged in it are not yet aware of the extent to which it is possible to introduce exact method into such studies; they need to be more fully acquainted with the practise of scientific method and with the art of discovery. It would be more nearly correct to speak of

the movement as one for the promotion of nature love rather than as nature study. At present it involves far too little real study and concentration of purpose; which is unfortunate, as rural children particularly need training in exactness.

One branch of work initiated in the office of experiment stations at Washington of extreme importance, to which reference should also be made, is that relating to the nutrition of man, which has been carried out in various parts of the states under the supervision of my friend Professor Atwater—a fellow student with me in Germany in years gone by—who initiated the inquiry in 1877. The scope and results of the investigation are described in the report of the director of experiment stations for the year ending June, 1901. Undoubtedly the most important and valuable part of this work has been that done during recent years at the Wesleyan University, Middletown, Conn., where a large respiration chamber has been erected and brought to a remarkable state of perfection by Professors Atwater and Benedict. The installation is a very costly one. It is possible for a man to live within this chamber for days or even weeks and for account to be kept during the whole time, not only of the products of respiration, but also of the amount of heat given out and the oxygen consumed, with a degree of accuracy equal to that with which ordinary analyses are carried out in a laboratory. No better illustration can be given of the amount of thought and care which is now being devoted to investigations of practical importance in the United States. I went specially to Middletown to examine the apparatus and was gratified beyond measure; to see it alone was worth a pilgrimage to America. The investigations which can be carried out with such a chamber are of far-reaching importance and touch very closely on the domain of household economics. It is much to be desired that we, on this side, should be able to do similar work.

The geological survey is also a well-organized department in Washington. The wealth of material at the disposal of American geologists is extraordinary. If opportunity beget supply, we may look to America as the breeding ground of geologists in the future. Besides field work and the attendant office work, the department now carries on scientific research work on geological problems. It has a well-equipped chemical department, at the head of which is Professor Clarke, who a few months ago delivered in Manchester the lecture commemorative of the centenary of Dalton's atomic theory. Much valuable work has been done in this department, which is now quite the seat of authority in mineral analysis, Dr. Hillebrand, the senior member of Professor Clarke's staff, being probably the most accomplished and experienced analyst of the day.

Lastly, it may be mentioned that a bureau of standards has recently been established at Washington to do work on the lines of that done by our standards department, the board of trade and the national physical laboratory, but with a wider outlook than any of these and well provided with funds.

When we consider how uncoordinated our efforts are, how little public appreciation exists of the value of science to the community, it is impossible not to feel envious of what is going on in Washington. It would well repay us to inquire very fully into the causes which have operated to produce a willingness in America to listen to counsel which here passes altogether unheeded. Something must be done to create a public belief in the value of knowledge, which will lead us to coordinate our scattered efforts. So long as our outlook is merely insular the future may appear to afford little promise; but if we consider

the possibilities the empire affords, there is no reason why our outlook should not be as hopeful as that of the United States. The resources at our disposal, the agricultural possibilities within the empire, may well be regarded as boundless; but we need to make ourselves acquainted with them and to take concerted measures to exploit them. To this end, it is all-important to constitute effective central organizations in this country similar to those which exist in the United States.

One other illustration may be given. In New York, on the occasion of our visit to the Museum of Natural History, Professor Bickmore, to whom this magnificent museum owes its origin, favored us with an account of the manner in which material was provided for illustrated free popular lectures delivered at the museum, for the purpose of making the people acquainted with their country and its resources; and he delivered a charming lecture to us in illustration of the work. The lantern slides prepared in the museum are placed on sale, so that they can be used for educational purposes all over the country. The lecture we heard was of a very popular character; it was quite clear, however, that pioneer work of a most useful character was being done. It was impossible not to feel that if the resources of the British Museum were were made known by sound popular lectures and handbooks; if the museum, the ordnance and the geological survey departments and the colonial office were to cooperate with the education department in making known the conditions which prevail throughout our Empire, it would at once be possible to put the teaching of history and geography on a basis of fact and make these subjects eminently attractive. The geological survey exists as a branch of the educational department, but its reports are of technical rather than of educational value; they might well, in part, be so written as to be delightful essays on physical geography suitable for school use, if only a little thought were given to them from this point of view.

It is quite clear that the right spirit is at work in the United States; but the lack of the critical faculty and of depth of purpose, combined with an excessive development of the utilitarian spirit, are serious drawbacks at present and militate against progress in education. Until higher ideals prevail and sober calculation takes the place of a somewhat emotional and superficial consideration of its problems, it will be difficult to introduce reforms. Here our difficulty is to break through academic, conservative traditions and to arouse an interest in education; that in reality it is the most important of all subjects to be seriously considered has never yet been made clear to us either by preacher or by politician—the message awaits delivery and we need more than anything else the man to make it heard.

Henry E. Armstrong.

SCIENTIFIC BOOKS.

The Metric Fallacy, by Frederick A. Halsey, and *The Metric Failure in the Textile Industry,* by Samuel S. Dale. New York, D. Van Nostrand Company. 1904. Pp. 231.

A bill was introduced in congress in 1902 with a view to the general adoption of the metric system of weights and measures in the United States. The committee on coinage, weights and measures secured the views of a number of prominent representatives of different professions, trades and manufacturing interests, the majority of whom favored the bill. A change of such fundamental importance required mature deliberation; and the committee were disposed to allow the fullest opportunity for discussion on the part of opponents as well as advocates. The bill will not be brought to a third reading for some months yet, and congress will not be apt to take any precipitate action.

Mr. Frederick A. Halsey, associate editor of the *American Machinist,* presented a paper to the American Society of Mechanical Engineers in December, 1902, in which his aim was to rebut the arguments of those who had advocated the metric system, and especially to show how great would be the cost of the change to the mechanical industries of the country. Mr. Samuel S. Dale, editor of the *Textile World Record,* published some articles with the same object in view, particularly in relation to textile interests. The final result is the volume now before us.

The two parts of this volume are very different in tone, and it would be unfair to use the same words of criticism for both. Mr. Halsey's mental attitude is fairly indicated by the following extracts from his introductory chapter. He says (p. 12) of the metric system: "Nowhere has the system made material progress in industry except when backed by the policeman's club. * * * With their system of weights and measures as a foundation, the English-speaking peoples have built up the greatest commercial and industrial structure the world has known. They are asked to enter the slough of despond in which metric Europe wallows in order to help metric Europe out. They are asked to destroy the very warp and woof of their own vast industrial fabric in order that they may assist in weaving another of alien origin and with no resulting gain except to aliens. * * * Representative of their historic methods of development, foundation of their industrial life and bond of union between all sections—shall all these be destroyed for this French fad?" (p. 14). "The pro-metric argument is, substantially, an *a priori* argument. The metric advocates adopt the methods of the old philosophers who laboriously sought to prove what ought to be. My method is that of modern science, which interrogates nature in order to learn what is."

The last paragraph just cited is Mr. Halsey's comment after quoting the views of a number of pro-metric advocates, including such representatives of science as Elihu Thomson, Harvey W. Wiley, S. W. Stratton, Simon Newcomb and Lord Kelvin. Each reader can draw appropriate conclusions regarding Mr. Halsey's estimate of facts without any comparison of personal standing. That his attitude is marked by judicial fairness and dignity can scarcely be claimed any more than that such method is 'that of modern science.' The objects of his criticism are men who have already manifested ability at least equal to that of Mr. Halsey in interrogating nature. What he writes about wallowing in a slough of despond and sacrificing our advantages for the benefit of aliens, all for a French fad, might, perhaps, be called political claptrap of the same value as the cries about 'infant industries,' 'pauper labor' and 'sixteen-to-one.' It certainly is not argument. It emphasizes, what is evident on every page of his book, that he is a carping critic, much given to extreme forms of expression. For example, after quoting Dr. Wiley, Professor Newcomb and Dr. Geddes, he criticizes in these words (p. 96): "Was there ever such a case of distorted perspective? Was there ever such a case of rainbow chasing? As an epitome of the reasons for making this great change this pamphlet is pitiful. Are we a nation of dreaming idealists and transcendentalists that we should be swayed by such considerations?" The man who advocates the displacement of the old standards, he says (p. 97), 'deserves to be placed in the pillory and held up to the scorn of men.' Really, this is somewhat disturbing. It might be considered intolerant if its author were not so evidently a victim of what Mark Twain has aptly called 'French calm.' Such expressions make it hard to take seriously what he writes. A wide but very uncertain margin of discount is naturally suggested. The writer who resorts to sarcasm whenever the chance is presented, who confounds railing with argument, who suppresses or belittles everything that tends to controvert what he wishes to advocate, has only himself to blame if he forfeits the confidence of those who consider fairness an essential element in the effort to get at the truth.

The metric controversy may be summed up in a very few words. Certain people wish to give to our weights and measures the same

simplicity that characterizes our system of coinage, and in the remote future to attain international unity of coinage, weights and measures. Certain other people would lose money and otherwise suffer much inconvenience by the change. No good can result from calling the former doctrinaires or denouncing the latter as selfish. We have to consider the practical question, is the game worth the candle? If so, how can the transition be made least burdensome? If not, how can the existing system be improved with least inconvenience? Each of these questions may receive a different answer, and none of them will be fully answered during the twentieth century. The present writer has elsewhere taken part in the discussion and expressed the belief that if the metric system is to be popularly adopted at all by English-speaking nations it must be through some sort of compromise. Of his critics one scientific friend, a physicist (SCIENCE, Vol. XIX., p. 860), prefers to avoid compromise and believes that the American people will soon do what the French and Germans have done. Another, an engineer (p. 767), opposes all change of standards and thinks the proposed compromise 'might be a good one if the English-speaking race were to disappear from the earth.' The newspaper press has manifested similar diversity in views expressed.

The scientific men are probably as devoted to the metric system as the mechanical engineers are to its opposite. In the scientific laboratories no compromise whatever is now, or will be, necessary. The metric system will continue in use as the most convenient for laboratory purposes. But outside of the laboratory there are a good many considerations that can not be ignored. Even if intemperately urged and exaggerated, as they are by Mr. Halsey, they must be candidly recognized by those who advocate metric reform among the people, and allowance has to be made for two very obstinate and omnipresent opponents, conservatism and vested interests.

Mr. Halsey devotes a large part of his book to a presentation of statistical evidence intended to show that in all of the countries where the metric system has been made legal the people have held on to the old units to which they were accustomed. Adoption by statute is not a guarantee of adoption in practise. A century has not been sufficient to cause the abolition of old names and units among the common people in France, whether in city or country, resort to them being usual when no penalty is involved. The same is true in Germany and Switzerland, and in every other country where the metric system is in business transactions either obligatory or permissive. The fact is in no way remarkable. There is no reason to expect within the next century that conservatism will be so diminished that the exclusive use of the metric system will prevail even in France. The progress already made is all that could be reasonably expected. If the system be established by legal statute in America no such law can be enforced until the people generally shall have forgotten old names and values. If old names are retained and values but little changed the task of assimilation is made easier, but reasonably complete assimilation will take several generations. Thus, while our American coinage system is a model of simplicity and convenience, the rural Virginian persists in using the names 'shillings' and 'pence,' utterly superfluous as these may be. Advocates of the metric system deceive themselves if they think that new standards can be established among the masses, by statute or otherwise, within a few years. The initiative can be, and should be, taken by the central government, and in the application of the law all possible consideration should be accorded, particularly at first, to those whose large pecuniary interests are affected. The first result will be, not the abolition of confusion, but the increase of confusion by an addition to the units and standards in use. None of us to-day will live to see anything better than good progress on the part of the general public in getting accustomed to the new standards and losing devotion to the old ones.

That fairly good progress has been made, and will continue to be made, in the use of the metric system for international commerce may be inferred from the following extract,

printed by Mr. Halsey with another object in view. The collector of the port of New York says (p. 74):

> I have caused to be taken from the files of this office a number of invoices from Spain, Italy, Holland and Belgium, and find as follows: From Spain, 233 invoices, in 37 of which the weights are expressed as pounds, the remainder being made out according to the metric system; from Italy, 15 invoices, the weights therein expressed in the metric system; from Holland, 55 invoices, in 14 of which the weights are expressed as pounds, 11 of the 14 are expressed as pounds avoirdupois, and the other 3 invoices not stating the kind of pound, the remainder of the invoices being made out according to the metric system; from Belgium, 126 invoices, in 14 of which the weights are expressed in pounds, 31 in feet and inches, 2 in yards, and 1 in gallons; the remainder being made out according to the metric system.

This is very encouraging to those who believe that all great changes must be gradual. One of the anti-metric advocates writes: 'The question of weights deals rather with the future, but linear measures are tied irrevocably to the past.' The metric advocates should accept this statement with the substitution of 'strongly' for 'irrevocably.' If the statement were true as it stands, we should still be measuring lengths in cubits. The inch has not been invariable in the past. It may yet vary enough to become exactly commensurate with the centimeter if the exigencies of trade should make this desirable, but not otherwise. Or, unwelcome as such a proposition may be to the physicists, the meter, which we all admit to be an arbitrary standard, may yet be lengthened enough to become equal to forty inches. In either event readjustment implies inconvenience and opponents will be plentiful.

All fear about destroying the value of a vast body of technical literature founded on the English system is gratuitous. A very considerable body of literature has grown up, founded on the centimeter. Its value will not be destroyed if the millimeter should be lengthened to one twenty-fifth of an inch. Both the technical world and the scientific world have thus far readily adapted their literature to the times, with no regard for the inviolability of past usage. The fact that Newton's 'Principia' is now but little read does not take away its importance as the foundation of modern exact science. We simply adapt it to modern nomenclature and modern improved methods.

Mr. Halsey's book closes with these words, which apparently settle the case of the metric advocates for all time: 'These people may legislate until doomsday; they may make infinite confusion, endless turmoil, limitless sacrifice; but move the English inch?—the Archimedean lever is still unknown.' Dr. Lardner is credited with having proved that the Atlantic could never be crossed by a steam vessel. The rôle of the prophet is often unsafe; as unsafe as the exhibition of rage in print.

Mr. Dale in his discussion of the failure of the metric system to meet the requirements of those engaged in textile industry is in general more dispassionate than Mr. Halsey, but both writers exhibit considerable personal venom. This is intelligible, if it is not excusable, when we consider that each is a special representative of industries in which many millions of dollars are locked up in machinery that would all need to be changed if a law were passed that should impose a penalty upon the use of standards other than metric. Each considers that such coercion is implied in the legislation that has been provisionally discussed in committee at Washington. Mr. Dale, after criticizing some testimony in favor of the metric system that had been given to the committee by the president of a New England cotton mill and the principal of a textile school, says (p. 148): "This is the kind of evidence that was followed by a report bearing all the earmarks of having been dictated from that metric hothouse, the National Bureau of Standards." He calls the metric system a product of the French Revolution, associating it with the excesses of the Reign of Terror. He makes a violent attack on the personal character of the greatest of French mathematicians, whom he calls 'the designer of the metric system,' and who 'exhibited an utter disregard of principle in both private and public life' and 'appropriated the work of others as his own.' It is not uncommon to find men of genius who are deficient in administrative

ability; but even if we should admit that the author of 'The Nebular Hypothesis' was the ingrate, the time server, the fantastic visionary that he is here represented to be, it is hard to see what logical connection this can have with the question of international uniformity of weights and measures in the twentieth century. Mr. Dale seems to think that his cause, that of protection to textile industries, can be helped by such personalities. Of the great mathematician he says: "He was familiar with theories of infinity, but ignorant of the wants, necessities and limitations of textile manufacturing. The co-workers of this man in constructing the metric system differed from him only in degree. They were a party of mathematical prodigies, ignorant of the essentials of textile weights and measures."

The textile industry is undoubtedly important, but not enough so to warrant Mr. Dale's apparent assumption that knowledge of its technicalities is needed by the student of science or the legislator. That these technicalities are abundant and confusing is sufficiently shown in his chapter on 'The Continental Chaos.' This oldest of arts has always had its variable nomenclature, which has been developed without any reference to theoretic consistency or international uniformity. Even if the metric system had never been devised, the chaos could hardly have been much worse than what is here exposed. Attempts in France to dispel this chaos by legislation in behalf of the metric system have been rewarded with little or no success. Conservatism has been too strong and vested interests too great to permit the enforcement of any interfering laws. The statutes were passed, but had no life. Scarcely any better success has been had in Germany or, indeed, anywhere else. English and American textile standards seem to have been adopted away from home more than any others, this progress being entirely an incident of commercial convenience and not through legislation. Mr. Dale thinks that these textile standards will become the standards of the civilized world. Experience thus far certainly seems to indicate that legislation which contravenes custom in technical arts and manufactures is incapable of enforcement. Any attempts to secure change must be wholly unselfish, and directed toward the advantage of future generations rather than of present interests.

On the whole, this book is much to be commended to the attention of metric advocates, despite the unbalanced intolerance of Mr. Halsey and the ungenerous personality manifested by Mr. Dale. After discounting liberally for its bitter partisanship there remains a mass of information that must be taken into account by those who wish improvement in our system of weights and measures. If the metric system, so thoroughly installed in our laboratories, which are all new, is to be adopted in our industries, many of which are old, no proofs of its excellence will be of any practical value in securing the displacement of what gives satisfaction to those who control trade. If it is finally to win universality it will not be by legislation, but by its superiority, demonstrated by a multitude of trials in various fields, each initially on a small scale, and each suggested by the prospect of gain. Hope of general adoption within a few years after the passage of appropriate legislation has to be very limited. This statement does not imply that hope of its final adoption is to be abandoned. Nor must we claim that such adoption will simplify our weights and measures at first; it will merely add to the diversity; an addition to be deliberately made, with the prospect of the final disappearance of all except what experience may prove to be the best standards. Metric advocates believe these to be the metric standards. Before final adoption standards must be subjected to competition like all else, and only considerations of utility will determine the survival of the fittest.

There is no reason for metric advocates to relax their efforts to secure the adoption of the metric system by the government and its use in all government departments. An international system of weights and measures may gradually become established for the benefit of international commerce. Whether it will be adopted in interstate commerce can not now be predicted. Initial legislation should

be very elastic, and every concession should be accorded that may tend to secure to us the essential features of the metric system, even if we discard a good deal that its founders thought desirable for the sake of consistency. There is plenty of time yet to give this subject mature consideration without undertaking the rôle of either the optimist, the pessimist or the prophet.

W. LE CONTE STEVENS.

WASHINGTON AND LEE UNIVERSITY,
July 8, 1904.

The Development and Structure of Vegetation. Studies in the Vegetation of the State [of Nebraska], III. By FREDERIC E. CLEMENTS. Lincoln, Neb., published by the Botanical Seminar of the University of Nebraska. 1904. Pp. 175.

In the present work Professor Clements has had a double purpose, first, to give an account of our present knowledge of the cardinal concepts in the study of vegetation, viewed in the light of their historical development, and second, to give more exact organization and classification to those ideas as well as greater definition to their terminology. He treats the idea of the association in its various phases, and with its diverse bases; of invasion, with its elements, migration, ecesis (or adjustment to the habitat), influence of barriers, endemism, polygenesis, kinds and manner of invasion; of succession in its various phases; of zonation; and of alternation, involving competition. Each section has its bibliography. Many interesting views are presented in the course of the paper, among others the opinion that competition in plants has a purely physical basis, or, in other words, that competing plants influence one another only as physical, and not as physiological, agents. This view, which it must be admitted is the only one justified by facts at present at our command, would make associations and other groups of this nature merely physical mixtures of plants with no organic connection between the members (excluding parasites, etc.); but it is not improbable that further research will show this view to be incorrect. Another feature of the paper is the attempt of the author to give greater definition to the terminology of the subject, to which end he proposes many new terms, all of which have the positive merit that they are etymologically appropriate and consistent. Whether or not these merits will result in their adoption remains to be seen, but Professor Clements's proposals in this as in his earlier works have the great advantage of being first in the field. The author also emphasizes the need for accurate experimental and statistical field study as a basis for further ecological advance, a matter in which ecologists seem now to be in full agreement. Altogether, Professor Clements has given us a valuable and timely contribution to the study of this increasingly attractive subject, and his work is likely to exert no small influence in its development.

W. F. GANONG.

Mineral Tables. For Determination of Minerals by their Physical Properties. By ARTHUR S. EAKLE, Ph.D., Assistant Professor of Mineralogy, University of California. New York, John Wiley and Sons. 8vo. Pp. 72.

The new features in these tables are the prominence given to color as a classifying character and the restriction to the consideration of two hundred (approximately) common species. Lustre is made very subordinate, the divisions are by the 'streak,' color of the fine powder, and the subdivisions by 'color,' color of the mass.

For minerals which crush to a colored powder this affords an easy and generally accurate separation. But the silicates of all colors and many light-colored minerals yield white powders and their distinction by physical characters alone is not easy in average massive specimens, and this division extends over two thirds of the entire book. No resource is made to blowpipe tests, the inference to be drawn from a paragraph in the introduction being that 'blowpipe analysis' should follow as a separate feature of the course. The time allotted to mineralogy in many colleges would hardly permit this, however.

The omission of the rarer species and the limitation of the necessary apparatus to knife, magnet, lens, streak-plate and hardness scale

make the tables valuable for short courses or for field work. A. J. Moses.

SCIENTIFIC JOURNALS AND ARTICLES.

The July number (volume 5, number 3) of the *Transactions* of the American Mathematical Society contains the following papers:

E. B. Van Vleck: 'The convergence of algebraic continued fractions whose coefficients have limiting values.'

W. Findlay: 'The Sylow subgroups of the symmetric group.'

E. W. Brown: 'On the smaller perturbations of the lunar arguments.'

E. V. Huntington: 'Sets of independent postulates for the algebra of logic.'

H. F. Blichfeldt: 'On the order of linear homogeneous groups (second paper).'

J. B. Shaw: 'Algebras defined by finite groups.'

O. Veblen: 'A system of axioms for geometry.'

The contents of the *American Journal of Science* for July are as follows:

B. B. Boltwood: 'Ratio of Radium to Uranium in some Minerals.'

F. M. McClenahan: 'Constitution of Hydrous Thallic Chloride.'

E. H. Sellards: 'Study of the Structure of Paleozoic Cockroaches, with Descriptions of New Forms from the Coal Measures.'

W. A. Parks: 'Remarkable Parasite from the Devonian Rocks of the Hudson Bay Slope.'

C. R. Eastman: 'Asterolepid Appendages.'

A. B. Plowman: 'Electrotropism of Roots.'

O. C. Lester: 'Oxygen Absorption Bands of the Solar Spectrum.'

The Journal of Nervous and Mental Diseases of July, 1904, contains two articles dealing with Multiple Sclerosis, one by Drs. W. G. Spiller and C. D. Camp of Philadelphia containing a report of two cases and some general observations on the nature of the condition, and the other by Dr. Smith Ely Jelliffe, of New York, on the occurrence and etiology of multiple sclerosis, as observed since the opening of the Neurological Department in the Vanderbilt Clinic of New York City. The interesting fact is brought out that this disease is less frequent than in foreign countries. There is also a discussion of Uremic Hemiplegia, by Dr. T. H. Weisenburg, of Philadelphia, in which he gives reports of several cases, and the results of various experiments. The Periscope contains extended abstracts from *The American Journal of Insanity, Revue de Psychiatrie and Nouvelle Iconographie de la Salpêtrière,* as well as miscellany and reviews of the latest psychiatrical and neurological books, published in this country and abroad.

SOCIETIES AND ACADEMIES.

THE AMERICAN CHEMICAL SOCIETY.

NEW YORK SECTION.

At the last meeting of the season, held June 10, at the Chemists' Club, 108 West 55th Street, the section elected as officers for the ensuing year:

Chairman—Wm. Jay Schieffelin.

Vice-Chairman—F. D. Dodge.

Secretary-Treasurer—F. H. Pough.

Additional Members of Executive Committee—E. H. Miller, M. T. Bogert, Wm. McMurtrie and T. J. Parker.

The following papers were read:

Alloys (Illustrated): William Campbell.

This paper gave the results obtained in a continuation of the work reported at the January meeting. The work will appear in full in an early number of the *Journal of the American Chemical Society.*

The Optical Rotation of Some Cyclic Compounds: F. D. Dodge.

Dr. Dodge called attention to the fact that many of the constituents of the volatile oils contain ring-nuclei of three, four, five or six atoms, with varying degrees of saturation. These compounds are most frequently asymmetric; which is shown by the optical activity.

The questions as to how far the observed rotation phenomena are in harmony with the formulæ which have been proposed, and as to whether the van't Hoff hypothesis is universally applicable, were discussed. It is shown that in single ring nuclei, racemism is generally theoretically possible, and often observed. In the cases of some double nuclei (as the camphor group) racemism appears to be impossible owing to the peculiar molecular structure. The exceptional optical properties of *menthone* were discussed, and a possible explanation found in a peculiar isomerism

of the hexamethylene ring. 'Dextro' and 'lævo' menthone are shown to be not true optical isomens. Several other cases of rotation change were noted, and found to be due in general to chemical alteration of the nucleus.

The author emphasized the value of geometric formulæ, and especially a modification of the Kekulé-Baeyer tetrahedral models, and showed that certain plane formulæ, which have been seriously discussed, are impossible of construction by the models, and must be considered as, at least, improbable.

The Determination of Formaldehyde: R. H. WILLIAMS.

The author gave the results of a critical study of four of the more commonly used methods for the determination of formaldehyde. Two of these, the 'iodimetric' and the 'hydrogen peroxide' being oxidation methods, while the other two, the 'potassium cyanide' and Leglers's 'ammonia' methods, are based upon condensation reactions. The oxidation methods were found in all cases to give noticeably higher results than the condensation methods. Test analyses made with the addition of alcohol, aldehydes and acetone indicated that the difference was not due to the influence of other substances present in the formaldehyde solution, but to the reactions on which the methods are based. Paraformaldehyde may be determined as readily as formaldehyde, with any of the four methods mentioned. The formation and properties of the hexamethylene-tetramine, on which the ammonia method depends, will be studied further.

H. C. SHERMAN,
Secretary.

DISCUSSION AND CORRESPONDENCE.

ASYMMETRON LUCAYANUM IN BERMUDA.

BESIDES establishing the fact that *Amphioxus caribæus*—known since 1876 to exist at the Flatts—is found in numerous localities in these islands, the work of the station this year has resulted in the discovery that another representative of this very interesting group of Chordates—*Asymmetron lucayanum*—is also found in these waters. Especial credit for the discovery of this more rare animal is due to Mr. Louis L. Mowbray, a young Bermudian naturalist in the employ of the station.

E. L. MARK,
Director.

BERMUDA BIOLOGICAL STATION,
FLATTS, BERMUDA, July 22, 1904.

THE ASCENT OF WATER IN TREES.

TO THE EDITOR OF SCIENCE: It would not be necessary to notice at all the note on 'The Ascent of Water in Trees,' published in your issue for July 22, were plant physiologists and physicists alone to be considered. A single remark, for the benefit of those who might be misled, will suffice to show the futility of the theory proposed. The structures at the lower end of the conducting tissues are essentially identical with those at the upper end. If at the upper end the 'water ducts are protected from direct atmospheric pressure by their structures,' they are equally shielded from it below.

C. R. BARNES.

THE UNIVERSITY OF CHICAGO.

CONCERNING SPECTACLES.

RATHER an extensive literature exists on the question raised by Dr. C. Barck in his paper on 'The History of Spectacles' (SCIENCE, XX., July 8, 1904, p. 50) as to whether Nero was near-sighted and viewed gladiatorial combats with glasses. The passages in Pliny's 'Natural History' which have furnished food for this discussion occur in xi. 54, and xxxvii. 16; and the best interpretation thereof known to the writer of the present paragraph is found in Dr. August Nies's interesting thesis 'Zur Mineralogie des Plinius,' pp. 18–20 (Mayence, 1884). The claims of other alleged inventors of spectacles besides those mentioned by Dr. Barck are considered more or less fully in Beckmann's 'History of Inventions,' and in J. Fiedler's 'Geschichte der Erfindung der Fernröhre.'

C. R. E.

SPECIAL ARTICLES.

THE FORMATION OF TOXIC PRODUCTS BY VEGETABLE ENZYMES.

No subject in the domain of plant chemistry has aroused more discussion of late than the physiological rôle of the various enzymes.

Concerning the specific action of a few vegetable ferments, such as diastase, invertase and lipase, a fairly clear and definite idea has been formed, but as regards the functions of other enzymes, particularly those of oxidizing and reducing properties, our knowledge is much less precise, and the greatest diversity of opinion prevails.

As an example of the confusion which exists it is only necessary to review what has been written within the past few years regarding *catalase*. The property which extracts from animal and vegetable tissues possess of decomposing hydrogen peroxide was observed by Schoenbein in 1863, but Loew* was the first to ascribe the reaction to a specific enzyme—catalase—to which he attributed both oxidizing and reducing properties. Loew is of the opinion that, in the respiration processes of the living cell, hydrogen peroxide is formed and that this compound would act detrimentally were it not for the fact that it is destroyed immediately by the catalase. A similar view is shared by Pozzi-Escot,† who, however, declares that catalase is a reducing enzyme and has no oxidizing properties. Kastle‡ and Loevenhart, on the other hand, believe that catalase is concerned purely with oxidation phenomena and that Loew's suggestion, that it prevents the accumulation of hydrogen peroxide, is highly improbable. Without desiring to controvert any of the above opinions, I would like to suggest another possible explanation as to the rôle of the oxidizing and reducing enzymes.

In the course of experiments with sugar cane I have frequently observed that cane, which had been sterilized by steaming, suffers a more rapid deterioration through the attack of molds and bacteria than raw cane. This also holds true, but less noticeably, of the juices from steamed and raw cane. Another observation frequently made was that the juice from the upper green portion of a living cane was more resistant towards fermentation than juice from the riper joints lower down. The juice from the top of the cane also underwent a very rapid darkening after pressing, while that from the middle and bottom exhibited this change to a much less degree. The juice from steamed cane undergoes no coloration whatever. The change in color, resulting from the exposure of the juice or tissues of the cane to the air, is much better observed if the stalk be divided lengthwise; the darkening begins almost instantly in the region of the apex or growing point, and is less and less marked towards the bottom of the stalk. Such coloration phenomena are common to the tissues and juices of most plants and, according to Bertrand, are to be explained by the action of an oxidizing enzyme upon bodies of a tannin nature. Such bodies occur in fact in the sugar cane, and microchemic tests show them to be most abundant in the growing parts.

From the association of coloration phenomena with resistance to fermentation, it is natural to conclude that the dark-colored oxidation products produced by enzymes may have a toxic or germicidal action. That germicidal products, of even a very pronounced character, may be formed in cane juice by enzyme action was shown as follows: Samples of raw and sterilized juice from ripe cane were treated respectively with 0.2 per cent. of resorcin, orcin, pyrogallol and hydroquinone, and left exposed to the air. In every instance the sterilized juices began to ferment first; as regards the raw juices, those treated with resorcin and orcin showed the least resistance to fermentation and those treated with pyrogallol and hydroquinone the greatest. The raw juice treated with hydroquinone turned nearly black in color and remained perfectly preserved for many weeks. In this case the toxic agent was no doubt quinone, the presence of which was plainly indicated by the odor. In the oxidation processes which take place, through enzyme action, when the tissues of green plants are cut or bruised, a quinone body may be formed, or, perhaps, an organic peroxide of the asymmetric peracid

* Loew, U. S. Dept. Agr. Report No. 68. 'Catalase, a New Enzyme of General Occurrence.'

† Pozzi-Escot, *American Chemical Journal*, June, 1903, p. 552.

‡ Kastle and Loevenhart, *American Chemical Journal*, June, 1903, p. 583.

type, which latter group Freer* and Novy have demonstrated to be among the strongest germicides known. The formation of such toxic products would be of immense value to plants in protecting them against infection by micro-organisms, when their tissues are injured. Such protection would be most necessary in the regions of intense growth, and there in fact we find the oxidizing effect of the vegetable enzymes to be the greatest. The toxic products formed would undoubtedly have an injurious action upon the plant itself, were this not prevented by the reducing enzymes, which prevent the diffusion of these substances beyond their points of formation and requirement.

The oxidizing enzymes, no doubt, take part in other important physiological processes besides that of promoting the formation of toxic products. The importance of the latter function seems, however, to have been generally overlooked, and I believe it to constitute a phase of enzyme action well worthy of future investigation.

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THE ENDOSPERM ENZYME OF PHŒNIX DACTYLIFERA—PRELIMINARY REPORT.

THE presence of an enzyme in the resting endosperm of the date seed has been demonstrated as follows: After the embryos were excised from a quantity of seeds the endosperms were ground to a coarse powder and this powder digested cold for six hours with distilled water. The aqueous extract thus obtained was made 40 per cent. alcoholic, after which precipitate No. 1 settled. This precipitate was collected over asbestos and washed with alcohol while the filtrate No. 1 was raised to 80 per cent. alcoholic, after which precipitate No. 2 settled. This precipitate No. 2 was collected over asbestos and washed with alcohol. A portion of precipitate No. 1 was digested with 95 per cent. alcohol with constant shaking for fifteen minutes. The extract was filtered and evaporated to dryness over steam. A very slight residue remained which was insoluble in water and probably consisted of very fine asbestos which passed through the filter. This residue insoluble in water would not affect Fehling's solution, as was expected. The remainder of precipitate No. 1 was extracted with water and the extract filtered. The filtrate was made 50 per cent. alcoholic and digested ten days at laboratory temperatures, after which time it was evaporated to dryness over steam, yielding residue No. 1. This residue was digested for several hours with 95 per cent. alcohol, the extract filtered and evaporated to dryness, yielding residue No. 2, which was found to be very soluble in water and to reduce Fehling's solution. Precipitate No. 1, consisting of carbohydrates insoluble in 40 per cent. alcohol and any proteid either insoluble or carried down with the carbohydrates—evidently during the ten days' digestion in 50 per cent. alcohol—developed a reducing sugar soluble in 95 per cent. alcohol. Precipitate No. 2 was extracted with water and the extract filtered. The filtrate thus obtained was measured equally into four flasks. Into each flask 5 c.c. of soluble starch was titrated. Flasks *A* and *B* were immediately made 80 per cent. alcoholic. Flasks *C* and *D* remained without alcohol. All four flasks were digested at 40° C. for six hours. The solutions were then evaporated to dryness, yielding residues A_1, B_1, C_1, D_1. Each of these residues was then digested for several hours with 95 per cent. alcohol. The extracts were filtered, and after evaporation to dryness the residues A_2, B_2, C_2, D_2 thus obtained were dried for one hour at 110° C., removed to desiccator and weighed with following results. $A_2 = 0.0085$ gms., $B_2 = 0.0090$ gms., $C_2 = 0.0080$ gms. and $D_2 = 0.0085$ gms. All of these residues were soluble in water and reduced Fehling's solution with a total of 0.0030 gms. of CuO. Whether this reducing sugar developed from the soluble starch or from the carbohydrates present in precipitate No. 2 is unknown. Evidently the activity of the enzyme contained in precipitate No. 2 is not inhibited by 80 per cent. alcohol.

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* Freer and Novy, *American Chemical Journal*, 27, 161–192.

QUOTATIONS.

THE GERMAN YELLOW-FEVER EXPEDITION.

We recently referred in our news columns to the fact that not long ago the Institute for Ship and Tropical Diseases in Hamburg sent a fully equipped expedition to South America to study yellow fever in particular. The results already obtained by American, English and French observers will now be subjected to thorough tests, and further reports from the expedition will be awaited with much interest. We see in expeditions of this kind the strongest evidence of the great interest now felt in tropical diseases and hygiene. This movement seems to date back only a few years. The epochal discoveries of Patrick Manson and Ronald Ross were followed by the establishment in Liverpool of a school for tropical medicine by means of funds contributed by wide-awake and philanthropic business men. This school has sent out several investigative expeditions, the results of which have been important in the fight against malaria, and more recently in clearing up the etiology of sleeping sickness. In addition, this school gives courses in tropical medicine. Other seaports have followed the example of Liverpool, and similar institutions have been started in London, Hamburg, Bordeaux and elsewhere for teaching and research, location in seaport towns being necessary in order to gain access to the proper clinical material. The German expedition, which also is to study and report on sanitary conditions in South American harbors, is supported financially by the merchants of Hamburg. Whether viewed from the philanthropic or commercial point of view, the study of tropical diseases and maritime sanitation is so important that we can only rejoice because it is fast becoming a matter of international competition. It may not be out of order to ask what is being done in this field in the great seaports of the United States, in addition to guarding against the importation of infectious diseases. So far as we know there is now no place in America where a physician may receive special instruction of the proper kind in tropical diseases and allied subjects. We look for the establishment of an institution of this kind in Manila before long, but it is quite evident that there is room and need for one or more such institutes in the United States proper.—*Journal of the American Medical Association.*

CURRENT NOTES ON METEOROLOGY.

MONTHLY WEATHER REVIEW.

The Monthly Weather Review for March, 1904 (dated May 23), contains the following, among other articles: Professor R. F. Stupart, of the Canadian Meteorological Service, writes on the 'Origin of American Cold Waves,' stating his belief that cold waves may originate almost anywhere over the more northern portions of the continent, and also expressing a doubt in regard to the cold being due entirely to radiation. Rev. Chas. H. Lee, of Racine, Wis., reports that in winter clouds may often be observed gathering on the eastern horizon over Lake Michigan, and moving landward. These clouds are usually seen about noon, after a clear, cold morning, with a temperature of about 0° F. At first the surface of the lake steams 'like a boiling kettle.' Later the steaming ceases, and clouds break off and slowly float shoreward from a great mass of accumulated vapor over the lake to the east. A paper on 'Precipitation for Twenty-nine Years at Dodge City, Kansas,' by E. D. Emigh, leads to the conclusion that there is no foundation for the assertion that the rainfall in western Kansas is increasing from year to year. Rev. Marc Dechevrens, of the Observatory of St. Louis, Island of Jersey, contributes a description of the observations made by him on 'The Vertical Component of the Wind' on the island of Jersey, by means of the Dechevrens universal anemometer. To this article are appended notes by Professors Abbe and Marvin. H. H. Clayton, of the Blue Hill Observatory, contributes 'A Study of Some Errors of Kite Meteorographs and Observations on Mountains,' this being the result of the careful kite work done at Blue Hill since 1894. 'The Winter of 1903–04,' which was characterized by unusual cold east of the Mississippi River, is discussed by W. B. Stockman. The editor of the *Review* considers 'Uniformity in Meth-

ods and Standards of Instruction in Meteorology,' 'Weather Forecasts by Local Observers,' 'Polarization of the Light of the Sky' and other matters.

OCEAN METEOROLOGY.

CAPTAIN D. WILSON-BARKER, in his presidential address before the Royal Meteorological Society (*Quart. Journ. Roy. Met. Soc.*, XXX., April, 1904), believes that the solution of many meteorological problems should be sought in a closer study of the atmospheric conditions over the oceans. The work of Maury and Fitz Roy is appreciatively referred to, and the present state of our knowledge of marine meteorology is sketched. The author says: "In taking note of the meteorological work accomplished in different countries, we find the United States of America well to the fore. . . . The United States government is indefatigable in collecting knowledge beneficial to seamen." The opinion is expressed that we have reached the limits to which it is possible for us to go in weather forecasting with the meteorological knowledge at present within our reach. What is now required is a 'liberal infusion of scientific imagination into our midst.' There is appended to this paper a list of some of the publications bearing on marine meteorology issued between 1886 and 1903, and the illustrations comprise a series of charts of temperature, pressure, winds, rainfall and cloudiness over the oceans.

WHEAT IN CANADA.

IN the *Canadian Magazine* for April, Dr. Wm. Saunders, in discussing wheat-growing in Canada, states that he has received from Dunvegan, on the Peace River, 414 miles north of Winnipeg, samples of wheat weighing 64 pounds to the bushel, and from Fort Simpson, 818 miles north of Winnipeg, Ladoga wheat weighing 62½ pounds to the bushel has been obtained. Between sowing and harvesting the time varied between 101 and 108 days. The quick ripening of cereals in far northern latitudes is well known, and the successful cultivation of wheat in northern Canada means that the agricultural future of those northern territories is much brighter than was at one time supposed.

INTERNATIONAL CLOUD ATLAS.

A NEW edition of the 'International Cloud Atlas,' published in 1896 under the direction of de Bort, Hildebrandsson and Riggenbach, is to be undertaken, provided sufficient interest is shown in the matter by scientific men. The 'Atlas,' as is well known to readers of SCIENCE, presents views of cloud forms classified in accordance with the so-called international classification of clouds, which was officially adopted and recommended by the International Cloud Committee in 1891. The illustrations are beautifully colored, and quite apart from its great value to meteorology, the 'Cloud Atlas' is well worth owning for the beauty of the illustrations alone. It is to be hoped that all those who have found the atlas useful in their work will communicate with the committee in charge of the publication of the new edition.

BRITISH METEOROLOGICAL COUNCIL.

THE committee appointed by the British treasury in December, 1902, 'to inquire and report as to the administration by the meteorological council of the existing parliamentary grant, and as to whether any changes in its apportionment are desirable in the interest of meteorological science, and to make any further recommendations which may occur to them, with a view to increasing the utility of the grant,' has made its recommendations. These include the reconstitution of the meteorological office as a department under the control of the board of agriculture and fisheries; the appointment of 'a man of science as a director of meteorology, appointed after consultation with the Royal Society'; the appointment of an advisory board of five members, two being nominated by the Royal Society, one being the hydrographer to the Admiralty, one being a representative of the Board of Trade, and one of the Board of Agriculture and Fisheries; and the appointment of a second officer as scientific assistant to the director. The other recommendations relate

to the transmission of daily weather reports by telegraph; the use of wireless telegraphy 'in providing advance news of weather on the Atlantic'; an increase of the office staff, and the provision of new quarters for the central office.

ANTARCTIC WINDS.

Dr. Erich von Drygalski, in a paper read before the Royal Geographical Society on April 25 last, on the German South Polar Expedition, calls special attention to the winds noted during the *Gauss* voyage to the far south. The zone of prevailing westerlies was left behind and a trough of low pressure was crossed, the ship remaining on the southern slope of this trough, where the pressure rises again to a maximum over the continent. Here the winds were found to be prevailingly easterly, 'which sweep down from the south over the vast uniform and but slightly inclined surfaces of the inland ice, and appear on the sea-board as easterly, foehn-like gales.' These gales, according to Dr. von Drygalski, give this south polar region its distinctive character, and also its limits, and by their frequency and uniformity 'they reveal the immensity and the homogeneous nature of those Antarctic lands.'

NOTES.

A. B. MacDowall (*Met. Zeitschr.*, XXI., 1904, 77–78) believes that during the last sixty years sunspot maxima have been accompanied in England by higher temperatures. He thus takes a view directly opposed to that of Köppen and Nordmann, who believe that the temperatures are higher (in the tropics) during sunspot minima. MacDowall also publishes curves of pressure at Ben Nevis Observatory and of the moon's phases, in which he considers the coincidence sufficiently marked to lead to a belief of cause and effect, and curves of relative humidity at Greenwich and of the moon's phases, which seem to him similarly related.

The Deutsche Seewarte (Hamburg) has begun the publication of a pilot chart, to be issued quarterly, of the North and Baltic Seas. The same institution has also lately begun to issue charts showing for 8 A.M. each day the distribution of pressure over the North Atlantic between Europe and North America, and also the force and direction of the wind. These charts are published as soon as possible after date.

Sir John Eliot, lately at the head of the Indian Meteorological Department, gives it as his opinion, as quoted in *Nature*, Vol. 69, 538, that 'the next development of weather study will almost certainly be in the direction of international or world meteorology, and its relation to the phenomena of sunspots and terrestrial magnetism.'

Two recent studies on the vertical distribution of temperature in the free air are the following: R. Assmann, 'The Temperature of the Air above Berlin,' translated in *Monthly Weather Review*, XXXII., 1904, 177–180; L. T. de Bort, 'Décroissance de la Température avec la Hauteur dans la Région de Paris,' *Ciel et Terre*, XXIV., 1904, 579–583.

The Prussian Meteorological Institute has issued a new (second) revised edition of its 'Anleitung zur Anstellung und Berechnung meteorologischer Beobachtungen.' The first part deals with observations at second and third order stations.

R. DeC. Ward.

Harvard University.

STOMACH STONES AND FOOD OF PLESIOSAURS.

In a recent paper* on North American Plesiosaurs, Dr. S. W. Williston, in discussing the probable significance of the pebbles so often found associated with plesiosaur remains, says: "What the use of these pebbles was I will not venture to say. They may have served as a sort of weight to regulate the specific gravity of the animals or they may have been swallowed accidentally. If, as I believe probable, the plesiosaurs were in the habit of feeding upon invertebrate animals, seeking such in the shallow muddy bottoms, the pebbles may have been taken with the food unintentionally. I doubt this, however. I may add that all specimens do not reveal similar pebbles."

* Field Columbian Museum Publication number 73, page 75.

During the summer of 1903 the writer collected fossils in the Niobrara shales in South Dakota, finding the remains of many plesiosaurs. In nearly every instance a large number of siliceous stones were found associated with the bones, often embedded in the matrix en masse. In one specimen in which the largest dorsal vertebræ were four inches in diameter, there was at least half a bushel of these stomach stones, ranging from the size of a walnut to four inches across.

Considering the weight of these stones, the wonder is that so many specimens contain them. One would expect that when the flesh began to decompose, the weight of these stones would be too great to be contained by the weakened tissues and that they would be lost before the animal reached its final resting place. This may well explain the absence of stones in some cases.

Throughout the Niobrara formation in Dakota baculites are very abundant while scaphites are rare, especially in the shales. I could not be certain that any of the baculites associated with the plesiosaur remains had been eaten by these animals but in plesiosaur specimen number 5803 of the American Museum collection I found a variety of fossils representing this animal's last meal. Great numbers of fish vertebræ were scattered among the bones, while there were several pterodactyl bones, broken in small sections. But of chief interest were seven scaphites, more or less broken, which had without question been eaten by this animal. One other specimen had scaphites associated with it. The conclusion seems evident that invertebrate animals formed a large part of the food of plesiosaurs and that, in default of crushing teeth, the breaking up of the food was effected by the aid of these stomach stones, the presence of which further implies a thick-walled, gizzard-like arrangement in the alimentary canal.

BARNUM BROWN.

THE ALPINE LABORATORY OF THE BOTANICAL SEMINAR OF THE UNIVERSITY OF NEBRASKA.

THE striking diversity of conditions and of vegetation in high mountain ranges makes them ideal places for field experiment. Their value is greatly increased, moreover, when their slopes arise directly from the plain, as in frontal ranges. This is the case at Pikes Peak in the Rampart range of the Rocky Mountains, where the distance from the plains at an altitude of 1,800 meters to the alpine summit at 4,200 meters is less than ten miles. The significance of this is evident when one reflects that these ten miles contain in miniature the habitats and formations found between latitude 40° and the arctic circle: in less than a half-day, one may pass from the temperate zone through the boreal-subalpine to the arctic-alpine zone. The opportunity for the study of the development and structure of vegetation is unique. The major zones are in evidence as nowhere else, and their ecotones are clear-cut. Weathering and erosion are at a maximum, making new habitats and destroying old ones, and the developmental history of formations may be read from hundreds of stages. Experimental methods in vegetation and in the evolution of new forms may be applied with an ease and a certainty of freedom from accidents and interference which can be obtained only with difficulty in other regions. The dream of the physiologist (ecologist) to have his laboratory out-of-doors may be realized here, and it is merely a matter of time until methods will be found by which research will deal primarily with the experiments of nature, and the walled laboratory will be relegated to a purely secondary place.

The reconnoissance work done by different members of the botanical seminar of the University of Nebraska in various parts of the Rocky Mountains from 1893 to 1898 showed that the Pikes Peak region possesses the combined advantages of accessibility and diversity to a degree found nowhere else. This country was worked over more in detail in the summer of 1899, and Minnehaha, at an altitude of 2,500 m. on the Cog railway, was selected as a base. Minnehaha is within an hour's walk of the plains, and an easy climb of two hours brings one to timber line on Mount Baldy. It is in the midst of the coniferous and aspen forests of the subalpine zone, in a locality

peculiarly rich in talus and burn successions. Within a radius of five miles are found more than twenty distinct plant formations. In 1903, stations were established at Manitou at 1,900 m., and on the top of Mount Garfield at 3,800 m., and automatic records were obtained throughout the growing season for the three zones, foothill, subalpine and alpine. During the present season, these stations are to be equipped with thermographs, psychrographs and automatic photometers, while water-content determinations will be made at stated intervals. A small cabin has been acquired at Minnehaha, and it is intended to convert this into a laboratory ultimately. It is the purpose of the alpine laboratory to carry on investigations under field conditions alone, and the building will be equipped only with such books, microscopes and other instruments as are necessary to field experiment.

The general phytogeographical survey of the Colorado mountains, which was begun in 1896, has been carried out along new lines in vegetational research, and is now nearly completed. The structural characteristics of the mountain formations have already been indicated in a series of formation herbaria, entitled 'Herbaria Formationum Coloradensium,' issued in 1902, while the methods of research employed have just been published in a paper, 'The Development and Structure of Vegetation.' A large number of permanent and denuded quadrats have been established for the experimental study of invasion and competition, and considerable work in experimental ecology has been initiated by changing habitats and transferring species to diverse habitats. Special problems in succession and adaptation are under investigation by advanced students, and the results will appear during the coming year.

The facilities of the laboratory are at the disposal of botanists and students desiring to do advanced work or to carry on investigation, upon the payment of a nominal fee. Good accommodations may be secured at reasonable rates in the mountain hotels at Minnehaha and Halfway. Minnehaha is reached from Manitou by the trains of the Cog railway, over which commutation tickets may be obtained at reduced rates. Detailed information will be furnished upon application to Dr. Frederic E. Clements, The University of Nebraska, Lincoln, Nebraska.

THE CULTIVATION OF COTTON IN THE WEST INDIES.

It is satisfactory to report that the experimental cultivation of cotton in the West Indies has proved a success, and that the industry is now established on a commercial basis. Plantations exist in Barbados, St. Lucia, St. Vincent, Montserrat, Antigua, St. Kitts, Trinidad, and the smaller islands, while plots have also been started in Jamaica and British Guiana. The total area estimated to be under cultivation is 4,000 acres. During the season just ended Barbados alone shipped, up to March 31, 244 bales and two bags of cotton, weighing 61,000lb., and the gins have been busy since. The Imperial Department of Agriculture, which has the work in hand, has orders from planters for Sea Island seed sufficient to plant 7,000 acres, and as this quantity has been paid for the presumption is that it will be used. In Jamaica, where the pioneer work is being carried out by the Board of Agriculture, enough seed has been disposed of to plant 500 acres. A number of Syrians, who are acquainted with cotton-growing in Egypt, are engaged in the cultivation there. Central factories for ginning and pressing the cotton have been erected in the various islands, and a cotton gin expert from the Sea Islands has just completed four months' work on the machines, all of which are now in perfect working order. He states that the factory in St. Vincent is the best-arranged and best equipped he has ever seen. A nine-hours' run of the six gins yielded 3,800lb. of lint; in Barbados, where the methods and appliances are not so scientifically complete, a similar run gave from 1,500lb. to 1,600lb. There are a few private ginneries, but the majority are government undertakings carried on under the direction of the Imperial Department of Agriculture. The cotton is ginned, baled and shipped for the planters for 3c. per lb. of lint; seed cotton is also purchased at the rate of 4c. per lb., which is

equivalent to payment at the rate of about 11d. per lb. for the lint in the Liverpool market. The prices obtained for the Sea Island cotton have been highly satisfactory. One recent consignment from Barbados was valued at from 16d. to 17d. per lb., another averaged just under 15d., the highest price being 16½d., and the lowest 13d. Prices current exhibited in Barbados at the same time showed that Sea Island cotton was being quoted in Savannah at from 10d. to 12½d., but this was evidently the price for common lint, as the last crop on the Sea Islands brought from 30c. to 35c.—this, of course, representing the result of 30 odd years of careful selection and cultivation. The figures given are sufficient to indicate that West Indian cotton, grown from Sea Island seed, is capable of yielding a return quite equal to the finest product of America. It is calculated that, the yield of lint being assumed to be 204lb. per acre—the average in America—and the total cost of placing it in the Liverpool market 7d. per lb. for cotton fetching 12d. per lb., the net profit would be at the rate of £5 2s. per acre. Labor is cheaper in the West Indies than in the Southern States; the cotton gin expert referred to was amazed at the low value of the labor in Barbados.

Sir Daniel Morris, the head of the Imperial Department of Agriculture, is of opinion that the only cotton that should be grown in the West Indies is the Sea Island variety, which, it is well known, is a native of these islands. Other varieties are therefore being eliminated. Some planters favor the Upland, and even the indigenous varieties which are still found growing wild, but it will undoubtedly prove more advantageous to devote attention only to the highly cultivated long-staple Sea Island cotton. The area throughout the world suitable for the growth of Upland is unlimited; that able to produce Sea Island is strictly limited. The latter fetches double the price of any other cotton, and like Blue Mountain coffee, will remain unaffected by future fluctuations of the market. A sample of the native cotton of Jamaica has been sent to England and pronounced very fine, being valued at 14d. per lb. It is a cotton which appears to resist insect pests, and many think that a first-class variety might be evolved from it. The experiments in the island, however, are being made with Sea Island seed, and it will probably be found wiser to begin where the Sea Island planters have left off than to engage in experiments which may not prove successful.

Many difficulties have naturally been encountered in establishing the industry, owing largely to the inexperience and ignorance of the growers, the most formidable being the attack of the cotton worm. Remedies were not at hand, and loss was sustained, but the planters are now forearmed, and they believe themselves able to cope with any similar emergency. Every assistance is rendered to growers by the Imperial Agricultural Department, which has published and circulated an extensive literature on the subject. One of Sir Daniel Morris's latest ideas is to send the officers of the department to the various islands to deliver popular lectures on the industry with magic-lantern illustrations. He recommends, however, that only capable planters should go in for cotton-growing at present, and advises those who wish to come out to the West Indies to embark on planting on a large scale, to pay a visit first to St. Vincent, and study the conditions and opportunities there. Great credit is due to him for his indefatigable efforts to promote the industry during the past four years. West Indian planters are not very ready to strike out on new lines, and, but for the steady persistence and influence of the department, aided by practical assistance from the British Cotton Growers' Association and West Indian Committee, it is doubtful whether the present important results would have been achieved.

DECENNIAL PUBLICATIONS OF THE UNIVERSITY OF CHICAGO.

MOST of the eighteen volumes originally planned as decennial publications of the University of Chicago have been issued. The University Press announces the following as among the volumes that may be expected shortly:

Lectures on the Calculus of Variations. By OSKAR BOLZA.

This treatise is, in substance, a reproduction in considerably extended form of a series of lectures delivered by the author at the Colloquium held in connection with the summer meeting of the American Mathematical Society at Ithaca, N. Y., in August, 1901. It gives a detailed account of the typical and most important class of problems in the calculus of variations—in which an integral depending upon a plane curve and containing no higher but the first derivatives of the unknown functions is to be maximized or minimized—with special emphasis upon the progress of the theory during the last twenty-five years. The following topics are treated: (1) The older theory of the first and second variation from Euler to Jacobi, and the critical revision of its foundations and demonstrations by DuBois-Reymond, Scheeffer, Weierstrass and others. (2) Weierstrass's theory: the problem in parameter-representation, the fourth necessary condition; sufficient conditions. (3) Simplifications and extensions of Weierstrass's theory (especially by Kneser and Hilbert. (4) The so-called isoperimetric problems. (5) Hilbert's existence theorems.

The Study of Stellar Evolution: A Popular Account of Modern Methods of Astrophysical Research. By George Ellery Hale.

The purpose of this book is to tell how the origin, development, and decay of celestial bodies are studied in a modern observatory. The remarkable advances in astronomy during the second half of the nineteenth century, including the development of great telescopes, the introduction of the spectroscope, the many discoveries made with its aid and the results obtained through the use of photography, have given the study of stellar evolution a prominent place in the work of many observatories. The explanations of instruments and methods are accompanied by illustrations, and the most recent astronomical photographs obtained with the telescopes of the Yerkes Observatory are reproduced in a series of plates.

Glacial Studies in Greenland. By Thomas Chrowder Chamberlin.

This book will consist of a detailed description of about fifteen Greenland ice tongues, and of a portion of the main ice cap, dwelling especially upon the significant features, followed by a chapter on generalizations, a chapter on experiments, a chapter on theoretical deductions and a chapter on the applicability of the generalizations and deductions to the great ice invasions of the past.

Studies in General Physiology. In two Parts. By Jacques Loeb.

This work will contain some of the author's principal papers on the subjects of animal tropisms, heteromorphosis and artificial transformation of organs, artificial parthenogenesis, physiological effects of ions, the effects of lack of oxygen, function of cell nucleus, etc. These papers have appeared in scattered German periodicals or as separate publications in German, and many of them are now out of print or inaccessible.

DR. J. C. McCONNELL.

In the death of Dr. J. C. McConnell, anatomist of the Army Medical Museum, which occurred on July 25 at Liberty, N. Y., where he had gone for recuperation, more than one science has lost an efficient coadjutor. Apart from the profession of medicine and anatomy and their application to the duties of his office, Dr. McConnell utilized his leisure as a delineator of objects of natural history, especially shells and fossils, crania and bones. He had for nearly thirty-five years carried on this work, and it is certain that as a draughtsman in black and white line, for scientific purposes, he had no equal in this country, if in the world.

About his last important work was the completion of the drawings for the illustration of the still unpublished Miocene volume of the Maryland Geological Survey. Many thousand exquisite drawings had been prepared by him for the National Museum and various surveys, as well as the Army Medical Museum, in the course of his career. To those requiring such service his loss is nothing short of a calamity. In his personal relations Dr. McConnell was attractive and genial. His official associates as well as those who knew him chiefly as an artist, will sympathetically join in the regrets of his bereaved family.

SCIENTIFIC NOTES AND NEWS.

DR. C. H. TITTMANN, chief of the Coast and Geodetic Survey, has left Washington for Alaska, where he will meet Dr. W. P. King, chief astronomer of Canada, in order to mark the boundary line between Alaska and Canada in accordance with the decisions of the commission that met last year in London.

MR. BAILEY WILLIS, of the U. S. Geological Survey, has returned from China, where he has been making geological explorations under the auspices of the Carnegie Institution.

PROFESSOR CHARLES E. BESSEY, of the University of Nebraska, is visiting the Minnesota Seaside Laboratory at Vancouver Island.

PROFESSOR H. H. RUSBY, of the New York College of Pharmacy, is at the Kew Botanical Gardens studying the herbaria from South America.

DR. T. HOMÉN, professor of physics at the University of Helsingfors, and three other professors of the university have been deported to Russia as a consequence of the assassination of General Bobrikoff. It is taken for granted that these professors had no connection with this crime, but in any case the conditions must be regarded as unfortunate.

THE senate of Heidelberg University proposes to establish a gold medal in honor of Professor Kuno Fischer to be conferred once in five years for work on the history of philosophy in Germany.

THE Paris Academy of Sciences has decided to award its LeCompte prize of the value of $10,000 to M. Blondlot for his researches on the so-called n-rays.

AT the celebration of the foundation of the University of Giessen on July 1, the rector, Dr. R. Brauns, made an address on the development of geology and mineralogy at the university since the year 1850.

A MEDALLION in memory of the late Sir George Gabriel Stokes, which has been erected in the north aisle of the choir of Westminster Abbey, was unveiled on July 7 by the Duke of Devonshire, chancellor of the University of Cambridge, and formally transferred to the authorities of the Abbey. Addresses were made by Sir William Huggins, Lord Rayleigh and Lord Kelvin.

THE monument erected to the memory of Pasteur in the Place de Breteuil, Paris, was unveiled on July 16 by President Loubet. In addition to Mme. Pasteur, there were present numerous officers of the government, members of the diplomatic corps and men of science.

WE learn from the *Journal of the American Medical Association* that Professor Czerny has endowed a prize in honor of his deceased father-in-law, the famous clinician, Adolf Kussmaul. The sum of $2,500 has been paid for the purpose to the Heidelberg University, and the income will be awarded every third year, on Kussmaul's birthday, February 22, for the best therapeutic achievement during the preceding three years, published first in German literature.

A PORTRAIT-BUST of Dr. Otto Kahler, formerly professor of medicine at Vienna, has been unveiled in the arcades of the school of medicine.

A PUBLIC meeting has been held at Bury, England, to celebrate the bi-centenary of the birth of John Kay, of Bury, inventor of the fly-shuttle, to promote a public fund for the erection of a statue in memory of the inventor and to institute scholarships.

MRS. MARY B. COULSTON, recently appointed assistant in agriculture in the University of California, died on July 17.

SIR JOHN SIMON, K.C.B., former vice-president of the Royal Society and president of the Royal College of Surgeons, well known for his important services on behalf of the public health, died on July 23, at the age of eighty-eight years.

MR. ALFRED H. ALLEN, the author of a well-known work in eight volumes on commercial organic analysis and of many papers on applied chemistry, died at Sheffield on July 14, at the age of sixty years.

DR. RUDOLPH AMANDUS PHILIPPI, for many years director of the Natural History Museum at Santiago, Chili, and the author of many contributions to zoology and botany, has died at the age of ninety-six years.

WE regret also to record the death of Dr. Gustav Hempel, professor of agriculture at

Vienna, and of Dr. Otto Christian Lovén, formerly professor of physiology at Stockholm.

M. Alfred Picard has been appointed commissioner of France at the St. Louis Exposition.

The American Mathematical Society will hold its eleventh summer meeting at St. Louis on September 16 and 17. The headquarters will be at the Inside Inn on the Exposition grounds. Professors H. S. White, A. S. Chessin and E. R. Hedrick are the committee in charge.

The French Association for the Advancement of Science meets at Grenoble from the fourth to the eleventh of August; the Swiss Association met at Wintherthour from July thirtieth to August the second.

The International Botanical Congress will meet in Vienna next year from June twelfth to eighteenth.

The trustees of the Percy Sladen Fund for the assistance of scientific research, the establishment of which with an endowment of $100,000 we recently noticed, have held their first meeting, and will meet again in November to consider applications for grants.

According to *Nature* the report of the committee on ancient earthworks and fortified enclosures was presented to the congress of archeological societies on July 6. The committee expresses regret that more archeological societies have not taken up the idea of compiling a schedule of the ancient defensive works in their respective districts; and it is urged upon the secretaries of societies to arrange, when possible, for the survey and scheduling of all such works as are included in the inquiry. The committee concludes the report by again impressing upon archeologists the importance of doing their utmost to prevent the destruction which from time to time threatens so many defensive enclosures of earth or stone.

The Journal of the American Medical Association states that the first subject for its prize essay is announced by the medical faculty of the University of Munich as follows: "It has been stated that mice can not be adequately nourished with pure food stuffs (albumin, fats, carbohydrates, mineral salts and water). Other investigators, on the other hand, have succeeded in accomplishing this. The faculty offers a prize for research in this line on pigeons, which can readily be fed on mixtures of the pure food stuffs." The subject announced for this year is given out again for further study for next year's competition: 'Study of the structure of the germinal vesicle in a large vertebrate.'

The *Scotia*, bearing the Scottish Antarctic Expedition, under the leadership of Mr. Bruce, has returned to Glasgow, bringing, it is said, valuable collections.

Reports have been received from Dr. Max Uhle, who, since the beginning of the year, has renewed his archeological explorations on the coast of Peru, carried on by him through the liberality of Mrs. Phoebe A. Hearst for the department of anthropology of the University of California. Dr. Uhle made new excavations at Ancon, in several parts of the so-called necropolis, with a view to determining the relative ages of the cultures represented by the different kinds of mummies and objects. After abundant material for this purpose had been obtained, excavations were made a short distance south of Ancon. Here, in a hitherto unsuspected deposit free from mummies, remains of an early culture distinct in character from any other in Peru were found. After completing his investigations at this spot, Dr. Uhle proceeded northward along the coast toward Supe or beyond.

We learn from the London *Times* that at the one hundred and fiftieth annual meeting of the Society of Arts held recently, the business consisted in the election of the new council and the reading of the report. The Prince of Wales was elected president for the third year in succession. The report stated that the society's Albert Medal had been awarded to Mr. Walter Crane in recognition of his services in the promotion of decorative art. The prizes given during the year included the Swiney Cup for a work on jurisprudence, the Owen Jones, Mulready, and North-London Exhibition Trust prizes for work by art students, and prizes for fire pre-

vention apparatus awarded at the International Fire Exhibition last year, while the Benjamin Shaw Trust prize is now under offer for a respirator for use in dangerous trades. The numbers of candidates at the examinations showed a large increase last year. The report concluded with some references to members of the society who had died during the past year, among the most memorable of whom were Sir Frederick Bramwell and Sir Henry Stanley.

'THE Economic Resources of the Northern Black Hills' is the title of an elaborate report recently published as Professional Paper No. 26 by the United States Geological Survey. The chief author of the paper is Dr. J. D. Irving, but chapters have been written by Mr. S. F. Emmons and Dr. T. A. Jaggar, Jr. The report is in two parts, the first part, on the general geology of the Northern Black Hills, being the work of Dr. Jaggar, and the second, on the mining geology of the region, that of Messrs. Irving and Emmons. The entire report fills 214 pages and includes over 40 illustrations. The area covered is comprised mainly within the Spearfish and Sturgis quadrangles, which were surveyed geologically in the summers of 1898 and 1899 under the direction of Mr. S. F. Emmons. These quadrangles include the major portion of the mineralized and productive territory, but as a few ore bodies that fall without its limits have been described the title has been expanded to cover the mining region of the northern Black Hills. Dr. Jaggar's treatment of the general geology of the district includes a discussion of its general structure, topography, drainage and stratigraphy. The intrusive porphyries are described in detail and the history of their intrusion is given. A description of the Algonkian, Cambrian, Ordovician, Carboniferous, Tertiary, and Quaternary formations of the district closes the first part of the report. In the second part of the report, which treats of the mining geology of the district, theoretical discussions are either excluded or made as brief as possible. The work is chiefly descriptive in character. The first four chapters describe (1) the ore deposits in Algonkian rocks, (2) those in Cambrian rocks, (3) those in Carboniferous rocks, and (4) those in rocks of recent origin. A fifth chapter is devoted to detailed descriptions of particular mines in the district.

SIR THOMAS ELLIOTT, for the British Board of Agriculture, has sent the following reply to the Association of Chambers of Commerce, who urged the importance of establishing a national school of forestry: "The president of the Board of Agriculture and Fisheries fully recognizes the importance which attaches to the question of afforestation and to the provision of a national system of instruction in forestry. Steps have already been taken in more than one direction to give effect to the recommendations of the departmental committee which was appointed in 1902, under the chairmanship of Mr. R. C. Munro Ferguson, M.P., to inquire into the subject. Through the agency of the Commissioners of Woods and Forests a school of forestry has been established in the Forest of Dean, and a movement is on foot for securing a suitable area of land in Scotland for the purpose of demonstrating scientific forestry. The board have taken steps to secure the establishment of at least two lectureships in forestry in England, and some of the leading universities and agricultural colleges have been giving attention to proposals under this head. The agricultural departments of the University College of North Wales, Bangor, and of the Durham College of Science, Newcastle-upon-Tyne, appeared to offer special advantages as centers of instruction in forestry, and grants in aid of the establishment of schemes of education in the subject will be made by the board to those institutions. The board hope that the arrangements thus made will result in a considerable improvement of the facilities available in this country for the acquirement of a knowledge of practical forestry."

THE following, according to *Nature*, is a summary of the prizes offered by the Belgian Academy for 1904 and 1905: For 1904, in mathematics and physics, critical phenomena in physics, viscosity of liquids, study of n-linear forms where $n > 3$, thermal conductivity of liquids and solutions, each a prize of 600

francs; unipolar induction of Weber, 800 francs. In natural sciences, the Cambrian rocks of Stavelot (Belgium), 800 francs; modifications produced in minerals by pressure, 600 francs; development of Amphioxus (see *Bulletin*, 1904, No. 4, for corrected announcement), 1,000 francs; effects of osmotic pressure in animal life, and Devonian flora of Belgium, each 600 francs; heterœcism of parasitic fungi, 800 francs; and physiological action of histones, 1,000 francs. All memoirs to be written in French or Flemish, and sent in before August 1, 1904. For 1905, in mathematics and physics, combinations of halogens, 1,000 francs; physical phenomena accompanying mutual dissociation of liquids, 800 francs; linear complexes of the third order, 600 francs; principal terms in the periodic deviations of the vertical, 600 francs. In natural science for the same year, effect of albuminoids in nutrition, reproduction of Dicyemidæ, formations intermediate between the Bruxellian and Tongrian in Brabant, geological age of certain Oligocene deposits in Belgium, sexuality of the individuals resulting from division of a single ovum in certain diœcious plants; prizes, 1,000 francs for each of these five subjects; silicates of Belgian rocks, etc., 800 francs. In addition to these ordinary prizes the academy will award the following: June 30, 1905, a Charles Lemaire prize relating to public works; June 30, 1904, a Louis Melsens prize for applied chemistry or physics; December 31, 1904, a Charles Lagrange prize for terrestrial physics; on May 1, 1906, a Selys Longchamps prize for researches on the Belgian fauna; on December 31, 1904, a Théophile Gluge prize for physiology; and in 1906 a François Deruyts prize for higher synthetic or analytic geometry.

UNIVERSITY AND EDUCATIONAL NEWS.

The Board of Aldermen, New York City, has appropriated $5,000,000 for the erection of new school buildings, and $316,000 for recreation centers, vacation schools and playgrounds.

The Company of Goldsmiths has given £5,000 to the University of London for polytechnic work at the Institute at New Cross recently given by the company to the university.

We learn from the London *Times* that the negotiations between the hebdomadal council of the University of Oxford, the council of the senate of the University of Cambridge, and the senate of the University of London, with a view to the establishment of a system of mutual recognition of entrance examinations and certificates which exempt from entrance examinations, have resulted in a report by a committee of representatives appointed by the three bodies. On the report the London senate, who have adopted a resolution expressing their general approval of the suggested scheme, and their willingness to make an arrangement with the Universities of Oxford and Cambridge, or either of them, upon the basis of the proposal contained therein. The council of the senate of the University of Cambridge have already expressed their readiness to recommend that university to adopt the scheme. The matter is still under the consideration of the hebdomadal council of the University of Oxford.

Burtis Burr Breese, Ph.D. (Columbia), now of the University of Tennessee, has been appointed professor of psychology at the University of Cincinnati.

At Johns Hopkins University, Dr. C. K. Swartz has been appointed instructor in geology and paleontology, and Dr. James Barnes assistant in physics.

At a recent meeting of the board of trustees of Lehigh University the following were promoted to assistant professorships: In chemistry, Dr. W. B. Schober; in biology, Dr. R. W. Hall; in English, Dr. Chas. H. Whitman; in civil engineering, Mr. W. L. Wilson.

Dr. Louis G. Heyn has been appointed assistant to the chair of chemistry in Miami Medical College, Cincinnati.

Dr. Wm. Litterer has been elected professor of histology, pathology and bacteriology in the medical department of Vanderbilt University, to succeed Dr. Louis Leroy, resigned.

M. Mangin, of the Lycée Louis le Grand, has been appointed professor of botany in the Paris Museum of Natural History.